

Chapter 2

Group Technology

Remarkable and Destructive Innovations

Abstract This chapter describes Group Technology (GT) objectives and methods. The main goal of GT is toward reducing throughput time in manufacturing single or small quantity of items. The proposed method is by reducing the waiting time of items on shop floor (95%) which is achieved by organizing the factory into work cell that can manufacture a family of parts. GT users claims of 230% rise in labour productivity and 240% rise in shop output. The concepts of GT spread and was used in many tasks as: process planning; concept design; purchasing; cost estimating; etc. The broad meaning of GT now covers all areas of the manufacturing process. General definition of GT concept is: “Group Technology” is the realization that many problems are similar and that by grouping together similar problems, a single solution can be found to a set of problems, thus saving time and effort.

2.1 Introduction

Group Technology (GT) is a manufacturing philosophy aimed at increasing productivity in manufacturing of the job-shop type.

In job shop, because of the variety of jobs encountered, and the small number of parts in each run, set-up time often represents the most significant portion of throughput time. Conventional methods had tried to increase productivity by using capacity planning to attack the direct machining time. As already mentioned, it has been claimed that only 5% of throughput time in producing a part is taken up by direct working time, whereas the part spends the other 95% waiting in the shop.

GT directs its effort toward reducing throughput time by attacking that remaining 95%. This is achieved through organizing the plant layout according to work-cell rather than function. To reiterate, a work-cell is a unit that includes all of the machines required to produce a family of parts. Raw material enters a cell and a finished part emerges. The reported success in reducing lead-time through this method is very impressive.

2.1.1 The Evolution of Group Technology

Mitrofanov [1], the man credited as most likely having coined the term “Group Technology,” was impressed by the results that he saw at a machine-tool works in the Soviet Union during the Second World War, where a reduction in set-up time of over 80% was achieved. The managers of the plant had organized specialized component sections with flow lines for the machining of specific groups of components with similarities in design and machining sequences.

In the same era, Petrov [2] had given a touch of academic mathematical detail to the question of production planning and machine loading. He emphasized the need to design special machines that could manufacture a certain family of parts while stressing the importance of utilizing special chucks, such as universal prisms, for use in a milling machine, to save time.

In the subsequent years, between 1950 and 1957, several enterprises engaged in medium and small batch production improved the production structure of their main shops by adapting GT.

As the foremen and operators gained experience, the machining techniques and sequences were corrected and, to some extent, standardized. Those employed in the sections concerned became familiar with group production techniques and ended up taking a more responsible attitude towards the quality of their work and the delivery of scheduled batches (groups) of components on time. Finally, the system was integrally tied up with improvements to the system of operational planning, since it reduced the degree of dependence on the performances of other sections. As a result, a wide variety of other general improvements in technology, and in the organization of the shops and the works as a whole, was achieved.

2.1.1.1 Benefits of Group Technology

Apart from the advantages in respect to production organization and planning, the setting up of specialized sections was found to improve the shop and works' cost figures quite significantly. One of the biggest cost advantages of GT is that it increases labor productivity, since each workplace can be specially designed for a definite operation on a specific component. This results in the reduction of labor and general production costs. Specialized sections can operate on a much shorter cycle time, because of the major reduction in what is known as ‘inter-operational delay’; in other words, the components take less time to pass through the production cycle. A shorter cycle time leads, in turn, to a smaller volume of work in progress and a more rapid release of tied-up capital. Sections organized to make specific components produce a better article, since narrow workplace specialization facilitates the adoption of rational techniques and the skill of the workers is improved.

A variety of enterprises have confirmed that, within 2–3 months of changing over to GT:

- labor productivity rises by 12–20%
- cost per unit value of finished products falls by 2–3%
- duration of machining cycle falls by 25–35%
- average value of work in progress falls by 15–25%.

In the years from 1957 to the mid-'70s, group technology was adapted as a universal manufacturing method. Its scope widened to cover all steps of manufacturing.

2.2 Definition of Group Technology¹

There are many definitions of group technology, and they are always subject to change as the scope of GT changes. It has been realized that this technology can serve as a solution for additional activities.

One of the first definitions of GT was given by Ivanov [3], who stated,

The main goal of GT is to produce a single or small quantity of items using mass production techniques.

Ivanov claims that GT has resulted in the achievement of a 270% rise in labor productivity and a 240% rise in shop output.

If we follow the literature on GT from the U.S.S.R. on its way west, we can sense the realization that the first goal of GT was probably something that could not be achieved. However, since the basic idea was a sound one, it was determined that this technique should not be altogether abandoned, but rather put into the proper perspective. Thus, we have V.R. Solaiya's definition of GT:

Group Technology is the realization that many problems are similar and that, by grouping together similar problems, a single solution can be found to a set of problems, thus saving time and effort.

And in Journal "Engineering" (1968) we find the following definition:

Group Technology is the technique of identifying and bringing together related or similar parts in a production process in order to utilize the inherent economy of flow production methods.

The general manufacturing philosophy of GT has now been accepted; in truth, it had been practiced under different names, or without any label whatsoever, even before receiving formal recognition.

Thus, the goals and applications of GT have expanded beyond the original requirement, that of the work-cell manufacturing technique, and the broad meaning

¹The material in this section has been adapted from 'The Role of Computers in Manufacturing Processes.' Author: Gideon Halevi. A Wiley-Interscience Publication. John Wiley & Sons, book ISBN 0-471-04383-4, 1980, pp. 76–78 with permission.

of Group Technology now covers all areas of the manufacturing process. The following is a list of such applications.

- Design. There have been improvements and savings in engineering design due to new methods of data retrieval, elimination of the duplication of drawings, and modification of older, similar drawings.
- Material management and purchasing. The use of groups of materials has led to greater purchasing efficiency, lower stock levels, and savings in procurement.
- Process planning. Savings in process planning have resulted from using the same process for a family of parts.
- Production control. Improved scheduling has resulted due to the similar setup of groups.
- Manufacturing. The use of flow-line systems, machine groups, and manufacturing cells has led to greater efficiency.
- Management. The grouping of parts for the evaluation of vendor quotations, cost, manufacturing load estimate and so on has led to improvements and savings.
- The main differences between GT and the conventional manufacturing system (including the IMS) lie in two areas:

1. *The engineering phase.* This phase was not treated systematically in the IMS. Modern GT offers systematic treatment. Although it merely involves a retrieval of parts according to similarity, the savings attributed to the use of GT are impressive. For example, one company reported that about 2500 new parts were released annually, while about 30,000 active parts were in its design files.

It has also been reported that between 5 and 10% of the annual output of new parts could be avoided through the proper use of classification and coding systems. Thus, a company could save anything from \$237,500 to \$475,000 just by reducing the duplicated design. This is without making anything; it simply involves preparing the part to go to the shop floor and be made.

2. *Target of attack.* The IMS tries to increase productivity by using capacity planning to attack the direct machining time. Group Technology, on the other hand, is concerned with the lead time. We return once again to the claim of 5% direct working time/95% waiting in the shop time. It is important to point out that the 5% can be further divided into 30% actual machining time and 70% for positioning, chucking, gauging, and so on. Hence, only 1.5% of the lead time is actual machining time, and GT directs its effort toward reducing lead time by attacking the remaining 98.5%. One way to achieve this is by organizing the plant layout according to work-cells, units that include all of the machines required to produce a family of parts, rather than functions.

2.3 Expectations of Group Technology

2.3.1 *Group Technology as Leading Technology*²

At this stage, Group Technology has become the leading technology in industry and academy. There can be no doubt that the problems of group technology and part families manufacturing are being widely studied and that companies all over the world are either in the process of trying to implement the resulting solutions or have already achieved a certain measure of success in doing so.

Koenigsberger [4], in his paper, describes the use of Group Technology in the industries of various countries.

- In the Netherlands [5], the Organization for Applied Scientific Research (TNO) has investigated Group Technology and its applications.
- In Belgium, the research center for the nation's metal industry (CRIF) "concluded that through using the Opitz system, it was possible to reduce the variety of work-pieces studied in this case from 30 to 12."
- In Sweden, a number of companies have introduced group technology under the guidance of a firm of consultants. "There is, therefore, general consensus of opinion concerning the value of the group technology method."
- In West Germany, "group technology has been applied for the investment planning of a new factory in which part families are collected in families which appear not only to have similar shapes but also to need similar typical operational sequences."
- In Japan, in 1976, a "Group Technology Studying Committee" was established. "This was followed by systematically introducing flowlines of cells into three companies with production control by computers, and also installing special machine tools, including some N.C. machines. Some results indicated that lead time fell from 5 to 6 days to an average of 1 day, the amount of scrap was reduced by about 50% and the production efficiency increased by 30%." [6].
- In Great Britain, the introduction of the group technology method has been reported in the manufacturing of the Brake Linings Company. "A feature of their philosophy was the concept of a cell as a 'synthetic machine' consisting of a highly utilized 'key plant' and a less utilized 'supporting plant'." [7].

"In conclusion, there can be no doubt that the problems of group technology and part family manufacturing are being widely studied and that companies all over the world are either in the process of trying to implement the resulting solution or have already achieved a certain measure of success in doing so."

²The material in this section has been adapted from the paper titled "The Use of Group Technology in the Industries of Various Countries" by F. Koenigsberger, published at the CIRP Annals 2, STC O, 21.2.1972, p. 209, with permission.

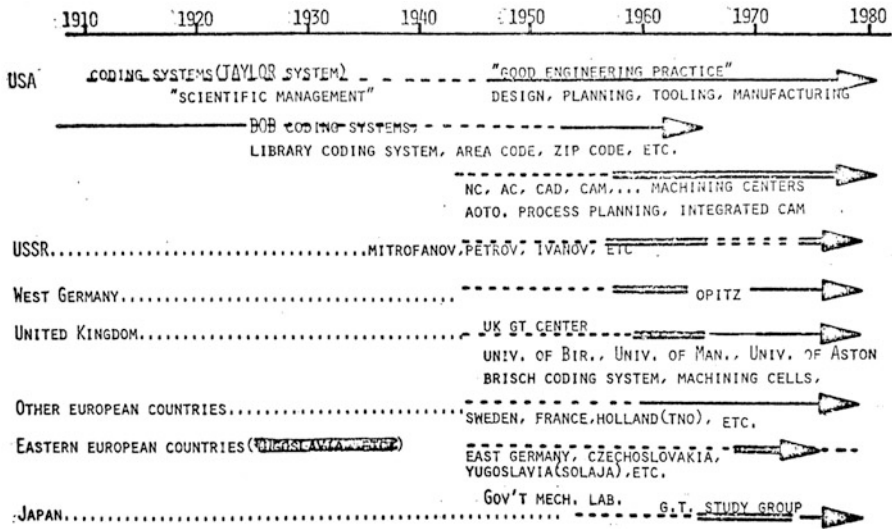


Fig. 2.1 Group technology applications in the US and other countries

A schematic diagram indicating the trend of group technology applications in the US and other countries was published by the CAM-I international seminar, held from April 21–23, 1976. The diagram, P-76-MM-02 on page 255, is shown in Fig. 2.1.

2.3.2 Predictions for Group Technology³

In his 1976 paper, 'State of group technology in the U.S.,' Inyong Ham made the following assessment of the potential for the use of Group Technology to spread.

One of the most important current problems in increasing manufacturing productivity is economic incentives. Manufacturing normally contributes approximately 30% of the gross national product of modern industrialized countries. It has been estimated that in the next decade, about 75% of all industrial parts produced in the U.S. will be on a small-lot basis, as opposed to about 25% at present. It is also reported that three-fourths of all U.S. metalworking production consists of lots numbering less than fifty pieces; furthermore, the metalworking industry employs almost 40% of the total employment in manufacturing in the U.S. The annual expenditure of the metalworking industry is estimated to be about fifty billion dollars. Thus, the potential for economic improvement of manufacturing by Group

³Material in this paragraph has been reprinted from the paper titled "State of group technology in the U.S." by Inyong Ham, Ph.D., Pennsylvania State University U.S.A., Published at the proceedings of CAM-I's international seminar, Atlanta, Georgia U.S.A. April 21–23, 1976, pp. 250–260, with No copyright and claims. Public Domain permission.

Technology is indeed not only critical and tremendous in the present day, but will continue to grow with time.

Another area for potentially significant improvement is more efficient utilization of highly expensive machine tools and centers. This task is an essential requirement for achieving the goal of the implementation of computer-automated manufacturing. Again, Group Technology provides a key element in the furtherance of this effort. A forecast of the future of production technology advancement, carried out by both the University of Michigan and the International Institute for Production Engineering Research (CIRP), strongly indicated that the computer-automated factory would be a reality well before the end of this century.

It is especially interesting to note that the survey by the University of Michigan predicts that, by **1988, more than 50% of industry will use Group Technology** in manufacturing, while **the survey by CIRP indicates that by 1990, 70% of industry will use Group Technology** in manufacturing. It is evident that new technological innovations, such as NC, AC, machining centers, industrial robots, new mini-computers, etc., will be continuously introduced toward more automated computer integrated manufacturing systems involving CAD/CAM, and thus lead to more integrated applications of Group Technology for optimum manufacturing and higher productivity.

A more recent survey conducted by CAM-I (Computer Aided Manufacturing International, Inc.) in April 1975 also provides strong evidence of the importance of the priority status of Group Technology applications for batch-type manufacturing industries, not only in the USA, but also in Europe and Japan. Although there are many areas of concern and a real need for improved techniques in manufacturing, it can be concluded that Group Technology is one of our most important methods of solving contemporary problems and improving manufacturing in the future.

2.4 Disappointments in Group Technology

Part families are crucial for application GT. Wikipedia (https://en.wikipedia.org/wiki/Group_technology) defines families as “The group of similar **parts** is known as **part family** and the group of machineries used to process an individual **part family** is known as machine cell. It is not necessary for each **part** of a **part family** to be processed by every machine of corresponding machine cell.

A part family is a collection of related parts that are nearly identical or similar. They are related through geometric shapes and/or size and require similar machining operations. Alternatively, they may be dissimilar in shape, but still related by having all or some common machining operations. Parts are similar in respect to production techniques when the type, sequence and number of operations are similar. This similarity is therefore related to the basic shape of the parts or to a number of shape elements contained within the part shape. The type of operation is determined by the methods of machining, the method of holding the part, and the tooling required.

The benefits of a good family forming method in connection with GT can be summarized as follows:

- Quick retrieval of design drawings and production plans.
- Design rationalization and reduction of design costs.
- Secure reliable work piece statistics.
- Accurate estimation of resource requirements.
- Reduction of set-up time and overall processing time.
- Improvement of tool design and reduction of tool design time, cost, and processing time.
- Rationalization of production planning procedures and scheduling.
- Accurate cost accounting and estimation.
- Better utilization of processing resources.

2.4.1 Form Families

There are three basic methods for the forming of a family of parts, namely:

1. Visual inspection—walking around the shop and looking.
2. Production flow analysis.
3. Classification and coding system.

2.4.1.1 Visual Inspection⁴

Many of the reports on successful group technology applications have come from studies in which the main work on the manufacturing concept was done with families of parts that had been organized manually. Engineers have tended towards taking a close look at each part produced by their company and making a human decision, relying on their memory and on the flexibility of the human mind. Therefore, this method is excellent for small companies for which the human mind might be capable of grasping all the parts produced by that company.

Although this method is generally considered to be the least accurate of the three, one of the first major success stories of GT in the United States involved making the changeover using the visual inspection method.

The visual inspection method has proven very useful in the implementation of Group Technology at times, but overall, it suffers in regard to accuracy and is therefore the least widely used of the three methods.

⁴Material in this paragraph has been reprinted from the paper titled “State of group technology in the U.S.” by Inyong Ham, Ph.D., Pennsylvania State University U.S.A., Published at the proceedings of CAM-I’S international seminar, Atlanta, Georgia U.S.A. April 21–23 1976, pp. 250–260, Public Domain permission.

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2.4.1.2 Production Flow Analysis

Production flow analysis (PFA) is a technique for analyzing the operation sequence and routing of the components through the machines in the plant [8, 9]. Parts with common operations and routes are grouped together and identified as a manufacturing part family. Similarly, the machines that produce that family can be gathered together to form the machines group cell. It should be assumed that the majority of parts made by the company belong to clearly defined families and the company's machines to clearly defined groups. Several mathematics algorithms were developed to compute the family of parts, usually they are based on Boolean algebra and they are quite simple by nature [10].

A preliminary study of components with the aid of a PFA or an operations matrix established the optimal arrangement of work-cells. Example: families grouped by part and machine number. In Fig. 2.2, the columns represent the machines, whose names and numbers are at the top. The rows represent parts, whose names and numbers are on the left. An “X” in a cell indicates the proper pairing of part and machine.

While the first matrix (Fig. 2.2) is, perhaps, closer to what one might encounter in real life, the second matrix (Fig. 2.3) has been designed to make the process a bit less opaque, clearly indicating which machines are likely to be grouped together as a cell. Computer programs are available for manipulating large matrices but they cannot solve the problem of inconsistent routings that is often encountered in a PFA analysis. Inconsistent routing means that similar parts use different machines. This occurs for a variety of reasons such as:

Fig. 2.2 PFA original matrix

Item	R3	R4	R5	R8	R9	R11	R13
P#1							X
P#2	X		X				
P#3	X	X	X				
P#4						X	
P#5	X	X	X				
P#6	X	X	X				
P#7						X	
P#8				X			
P#9				X	X		
P#10				X			

Fig. 2.3 PDF organized work-cell

Item	R3	R4	R5	R8	R9	R13	R11
P#10						X	
P#4							X
P#7							X
P#8				X			
P#9				X	X		
P#10				X			
P#2	X		X				
P#3	X	X	X				
P#5	X	X	X				
P#6	X	X	X				

One of the most prevalent problems in PFA is the issue of inconsistent routing, which refers to situations in which parts that are similar enough to be made on the same machine are instead sent to different machines. This can be the result of something as simple as having more material than one machine can handle and thus sending it to another, but even more frequently, it is the byproduct of different process planners having their own ideas based on their own experiences about what should go where and why. When a product is made by the same company over a considerable period of time, during which personnel are likely to change, perhaps several times over, this sort of thing is bound to happen.

2.4.1.3 Classification and Coding System

Industrial classification is a technique for arranging the individual parts comprising any aspect of a business in a logical and systematic hierarchy, whereby like things are brought together by virtue of their similarities and then separated by their essential differences.

There are a number of approaches to the formation of a classification system. Each approach offers certain advantages and disadvantages over the other. The coding is done by collecting drawings and associated production data together on one hand and the classification system on the other.

Classification and coding systems can be categorized as:

- Design-oriented systems based on attributes of part design.
- Production-oriented systems based on attributes of part manufacturing.

Each system calls for different characteristics.

Design-oriented requires that a retrieval request draw a limited number of drawings. Otherwise the engineer will prefer to design the required part, instead of comparing many drawings in the hope that one of the old drawings might fit its purpose. On the other hand the *production oriented* requires that a retrieving request will draw as many parts as possible.

2.4.2 Classification and Coding

A coding system establishes a code for each component in the company's data files. After coding, similarities between codes can be used to form families. The code, in general, represents information regarding the component size and data relevant to its machining requirements.

One of two different approaches is followed in constructing a coding system. The first approach is to establish a universal code that can be used for components of a given industry. Contrastingly, the second approach gives an outline of the procedure so as to establish a tailor-made code.

2.4.2.1 Coding Systems

A number of coding systems exists, each claiming to be superior in one aspect or another. However, general guidelines can be established for a good coding system for the purposes of GT. An appropriate classification system should have the following characteristics:

- Generally applicable to components or major classes of components designed and/or manufactured in different engineering firms of a certain industry.
- Easily definable and clearly unambiguous.
- Explicitly defined in all the factors which affect production methods and tools (e.g., configurational, dimensional, and accuracy parameters of components and production control data).
- Not subject to aging and designed to accommodate future developments.

The variations in codes resulting from the way the symbols are assigned can be grouped into three distinct types of code:

- Monocode or hierarchical code
- Polycode or attribute
- Hybrid or mixed code.

Monocode is a progressive, integrated coding system in which each digit qualifies and/or amplifies the information contained in the previous digit. Each digit may contain more than one descriptor or characteristic. The study of these similarities is ideal for combining similar parts.

The reference-like nature of monocode, which eschews the cataloging of strings of information such as work processes, makes it unsuited for the design side of manufacturing. But it does have the ability to store remarkable amounts of information using very little code, making it a very useful, if somewhat fragmented, reference indeed. On the other hand, it is often highly important to isolate and identify specific attributes of a part which may or may not be encompassed in the monocode. This isolation of attributes is performed by utilizing a polycode system.

Polycode is defined as a set of independent sequential codes, each digit or set of digits describing individual characteristic variations. Polycodes are often called “feature” codes. This means that each symbol always means the exact same thing (generally a facet of the product and its production process in this context), regardless of the other symbols with which it has been placed. The more complicated the manufacturing process, the longer the polycode (and some polycodes have been known to be quite long indeed).

The third type, **Hybrid Code** is the most widely used of the three, not surprisingly, as it represents the best aspects of both mono- and polycodes while avoiding their respective pitfalls. The mixture of monocode and polycode systems retains the advantages of both systems. Most coding systems use this code structure.

Forming a good classification system is quite a problem, and there are many specific companies that specialize in this field. Here is a list of some of the most prominent industrial coding systems:

- Opitz classification system (the University of Aachen in Germany [11, 12])
- The Brisch System (Brisch-Birn, Inc.) [13]
- CODE (Manufacturing Data System, Inc.) [14]
- SAGT (Systematic Approach to GT) [15]
- CUTPLAN (Metcut Associates)
- DCLASS (Brigham Young University, Provo, Utah)
- Miclass [16]
- MultiClass (OIR: Organization for Industrial Research)
- Part Analog System (Lovelace, Lawrence & Co., Inc.).

2.4.3 *Creating Part Families*¹

In order to utilize the benefits of GT, a classification and coding system is required. Ham [17] defines the requirements of this type of system as follows:

The system must be both design- or form-oriented and also production- or process-oriented. Care must be taken in formulating the process code so that the system can accommodate future changes in technology which may produce entirely new methods of processing the part family.

Many of the reports on successful GT applications have come from studies in which the main work on the manufacturing concept was done with families that had been organized by human effort. This is a byproduct of the standard approach taken by engineers, as mentioned in the section above on visual inspection.

The exhaustive research for selecting and determining the coding and classifications will need to meet the above specifications. Classification and coding systems can be categorized as design-oriented, production-oriented, or resource-oriented.

2.4.3.1 **Design-Oriented Classification and Coding Systems**

The first attempts to create classification and coding systems for components were specifically based on considerations of shape and size.

In my own previous paper, 'Adaptive Process-Production Planning' [18], I proved that the most economical process for producing components that have exactly the same shape and size will vary according to other considerations and requirements, such as quantity, raw material, and optimization criterion. Similar conclusions can be found in the paper by Hancock [19] from Group-Technology International, England, in which he writes:

While they met with some measure of success, it was found that the systems available at that time (early '60s), were design-oriented, and, projected into production-oriented systems, were not giving the results desired. Today, it is increasingly recognized that classification and coding of components by shape, etc., will not give the results desired.

Hancock goes further in developing his ideas and comes to a clear conclusion:

From my own experience in this field, and that of my colleagues, my conclusion is that no one can devise a coding and classification structure as a sieve or riddle by which, with the appropriate number of shakes, rattles and rolls, component families will emerge, around which we can design Group Technology cells.

2.4.3.2 Production-Oriented Classification and Coding Systems

The inadequacy of the design-oriented approach thus leads to the use of a production-oriented classification and coding system. Naturally, as a result, the design utilization of the GT technique is neglected. However, this is permissible, since it constituted a secondary rather than a primary objective.

This type of classification and coding system should be based on process planning; however, the present situation in process planning, excluding my own work [20], is a strictly human-oriented activity, highly dependent on individual skills, human memory, reference manuals, and experience.

Due to the fact that more than one engineer (or process planner) will tend to be involved in the decision and specification as to how things should be made in the current process planning file, we find different plans, different machines and different sequences for the same or similar components. Thus, if we use the current process plans as a basis for a classification and coding system, we probably will not achieve the results desired. Furthermore, Hancock [19] has found and stated that:

Many of the characteristics associated with production are either totally variable, or at best, semi-permanent. These include the production quantity, the manufacturing methods and the technological changes. To build these into a code structure would be very difficult.

The production-oriented approach to classification and coding has achieved some success in certain manufacturing industries, but has left many unsolved problems in others. Thus, even in those industries for which it may be a good approach, I am afraid it will only achieve short-term success, possibly proving disastrous in the long run. It is a rigid, baseless system that will not adapt itself to technological changes, and will, therefore, be a hindrance to technical development.

2.4.3.3 Resource-Oriented Classification and Coding Systems

The Resource-Oriented method calls for a machine layout according to a production flow analysis, in which a component will enter a work-cell and be terminated there. Hence, one work-cell or department might include sawing, milling, turning,

drilling, slot milling, grinding, lapping, and deep drawing. Technological improvements can be made in each work-cell according to the specific components to be manufactured within it. The extreme example of this is the automated job-shop, where a transfer line and automatic chucking are installed.

The work-cell method represents the latest approach to GT and the reports on its use inform us that it is “immensely successful,” showing “an average saving of 70% of machine time,” “work in progress reduced by a ratio of 8–1,” and so on. There is no reason to doubt the accuracy of these reports or that this is an excellent technique for certain types of industry.

A preliminary study of the components, with the aid of a PFA or an operations matrix, establishes the optimal arrangement of work-cells. Their classification and coding will be done through analysis of specifications so as to obtain the potential manufacturing work cell. Naturally, if the workpiece mix changes, a new study of the PFA should be made. Rearrangement of the work-cells and reclassification and recoding of the components should be carried out.

Before installing and using the work-cell concept, one should bear in mind the problems that will arise:

- *Reorganization.* The ability to reorganize the machine layout of the plant and, probably, to repeat the reorganization every so often.
- *Work-cell supervision.* In the functional layout, it is only required that the foreman be an expert in one type of manufacturing. In the work-cell concept, in order to supervise and instruct the workers, the foreman must be an expert in several fields, such as milling and turning.
- *Work distribution.* With the functional layout, there was no problem in transferring an operator from one machine to another, since they were of the same family and thus the operator had the training and skill to operate them both. In the work-cell environment, however, this cannot be done.

2.5 Summary

Group technology (GT) is a sound and widely accepted manufacturing philosophy. For practical applications of GT, the creation of part families is crucial. A part family is defined as a collection of related parts that are nearly identical or sufficiently similar. For several centuries, the traditional technique for forming such part families was through coding and classifications systems. The research on GT was sidetracked by research on classifications. Several methods were proposed, including: the Opitz system, which used 5 digit + 4 supplementary digits; the SAGT system, with 18 positions; and the TNO, with 31 digits completing a questionnaire of 75 lines.

Any classification and coding system will contain errors, owing either to the rigidity of the system or to human error in the classification and coding processes.

Houtzeel [21], in his paper describing the Miclass system [16], and based on his experience of seven years in development and testing, writes:

Errors are a serious problem for all conventional classification systems. Classification may start off accurately but within a few months errors may run as high as 30–40%.

Still, despite these potential drawbacks, a classification and coding system is essential if the advantages of GT are to be fully realized. And, as per Ham [17], design, form, production and process must all be taken into account as necessary, as must the possibility, when developing the process code, of technological changes down the line that may affect the methods for processing part families.

To make these demands of a classification and coding system is practically asking for the impossible.

In my 1978 paper, ‘GT, not coding and classification,’ [22], I wrote that: “Group Technology” (GT) is a sound and widely accepted manufacturing philosophy, but not too many practitioners have succeeded in applying it. The main problem rests with the popular concept that the ‘heart of GT’ depends on classification and coding systems. A great deal of effort has gone into developing such systems; little success with GT has resulted.

“But, when you analyze the concepts of GT and attempts at its implementation, one conclusion becomes clear: group technology can be effectively used without any need for a classification system. Startling? Well, let’s take a look at the aims and objectives of group technology...”

By the 1980s, due to the incapability of coding and classification to support group technology, both had begun fading, and by the mid-’80s, they had almost completely disappeared.

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